SOUTHWESTERN UNIVERSITY OF FINANCE AND ECONOMICS, SCHOOL OF FINANCE

Financial Econometrics I: Assignment Two

Instructor: Qiuhua Xu

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Due: 2020-4-21

1 KERNEL DENSITY ESTIMATOR

Step 1: Generate random numbers from standard Normal distribution with sample size $T = 1000$.[1] Let the generated sample be $\{x_1, \ldots, x_T\}$.

Step 2: Let $k(\cdot)$ be the Epanechnikov kernel, i.e.,

$$k(z) = \begin{cases} \frac{3}{4}(1 - z^2) & \text{if } |z| \leq 1, \\ 0 & \text{otherwise.} \end{cases}$$

For a fixed x_0, the kernel density estimator is given by

$$\hat{f}(x_0) = \frac{1}{Th} \sum_{t=1}^{T} k\left(\frac{x_t - x_0}{h}\right), \tag{1.1}$$

where h is a bandwidth. In practice, kernel estimation is sensitive to the choice of h. In Step 2, you are required to choose h based on the method called likelihood cross-validation, which chooses h to maximize the log likelihood function given by

$$\mathscr{L} = \sum_{t=1}^{T} \ln \hat{f}_{-t}(x_t), \tag{1.2}$$

[1] Remember to set a seed before the random number generation.

where

$$\hat{f}_{-t}(x_t) = \frac{1}{(T-1)h} \sum_{s=1, s\neq t}^{T} k(\frac{x_s - x_t}{h})$$

is the leave-one-out kernel estimator of $f(x_t)$.

Step 3: Using the optimal bandwidth h obtained in Step 2, estimate the density function evaluated at each sample point $x_t,\ t = 1, \ldots, T$. Compare your result with standard normal distribution.